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Two Protozoans from Great Salt Lake

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By David T. Jones

Amoeba flowersi new species

The amoeba inhabiting the waters of Great Salt Lake, which has been previously referred to *Amoeba limax* (Dujardin). Named for my colleague at the University of Utah, Dr. Seville Flowers. Type localtiy, Garfield Beach, Great Salt Lake, Utah. Type figures 1 to 3.

Small amoebae, 18 to 40 micra in diameter. Nucleus (n of fig. 2) obscure, appearing of the compact type, finely granular when stained with methylene blue. Nucleus often obscured both by food particles of a similar size and by pink and green algal cells in the cytoplasm, the green ones (a of fig. 1) probably symbiotic. The pink algal cells break down into clusters of angular granules of a bright red color (r of fig. 3). Dr. Flowers suggests that the intensification of the color may be due to the pH of the cytoplasm.

Pseudopodia are chiefly blunt lobopodia composed of ectoplasm only. These appear to grow rapidly from a small area of the margin, but while growing, suddenly the original margin gives way, resulting in an eruption of cytoplasm, that encompasses perhaps about a third of the circumference of the cell (as in fig. 2, dotted line). This usually stops the growth of the pseudopodium.

Pseudopodia are very variable at different dilutions. At concentrations around 20 per cent often only one broad pseudopodium appears (figs. 9-12), which makes the animal appear very "*limax*-like." At greater dilutions more pseudopodia appear, some of which are very delicate, thin, angular sheets of ectoplasm, similar to but smaller and narrower than, the pseudopodia of *Amoeba verrucosa* Ehrenberg. At higher concentrations these appeared to be nipple-like projections (fig. 3) as on *Amoeba guttula* Dujardin. Dr. Flowers, in an independent series of experiments at lesser concentrations (12 to 14 per cent), has shown these are capable of great distention (figs. 13-27 and figs. 28-39 are his drawings of the movements of two amoebae respectively). In these it is to be noticed that the thin pseudopodia apparently serve as holdfasts or anchoring projections. If the grip is retained as the amoeba moves in the opposite direction, these points of attachment are produced into the long thin attenuated pseudopodia trailing usually behind. The author later confirmed Dr. Flowers' observations.

In varying dilutions, a contractile vacuole appeared, as on the more resistant of Schaeffer's marine amoebae (Schaeffer, 1926, p. 19). *Amoeba flowersi*, like these, shows no crystals. Many aboebae were induced to form contractile vacuoles. One of these was observed to discharge three times in thirty minutes.

Scrapings of green algae living in 20 per cent to saturated concentrations show many cysts of *Amoeba flowersi*. These transparent cysts vary from 18 to 27 microns in diameter, usually approximating a sphere. The walls of a cyst vary from 1.5 to 2 microns according to size and irregularities. In some cases (as in fig. 8) thickenings occur on the walls. In watching amoebae emerge from cysts (as a result of dilution) it is evident that there are two or more pores in the cyst (see Curtis and Guthrie, 1938, p. 240).

Amoeba flowersi was evidently first observed by Vorhies (1917, p. 497) who commented on it as follows: "In March 1910, several jars of a series, including one of undiluted lake water, contained an abundance of these forms. The specimens were of two or three varieties or species, by far the most common being very like *Amoeba limax*. I should not have hesitated to call it that in a fresh-water culture. A class of some 15 students was well supplied with Amoebae for laboratory work from one of these jars." Miss Kirkpatrick (1934, p. 18) reviews Vorhies' account and restudies this species in 22 per cent cultures. She describes the cysts, also notes "the pseudopods are formed almost explosively." Miss Quinn (1940, p. 5) refers to "an amoeba, resembling *Amoeba linax*," which mis-spelling has appeared in some subsequent accounts.

In the meantime the term, *Amoeba limax*, originally applied to most any amoeba with a single pseudopodium, has become restricted to one fresh water form and even placed in a different genus, *Vahlkampfia limax* (Dujardin), which (according to Kudo, 1939, p. 310) has a vesicular nucleus and polar caps during nuclear division. Fresh water amoebae, formerly described as *limax*, are now being classified as *Amoeba guttula* Dujardin, *Amoeba limicola* Rhumbler, or *Amoeba striata* Penard, if they do not fit the description of *Vahlkampfia limax* (Dujardin). According to Roscoe (1944, p. 1) some such form has been reported by Tanner from Utah Lake. *Amoeba guttula* has been found in fresh water cultures taken at Salt Lake City. Schaeffer (1926, pp. 19-21) found a few of his marine species of amoebae resistant enough to change from salt to fresh water or vice versa. They withstood all concentrations but did not reproduce in fresh water, hence the cultures would die out therein. In spite of this remarkable resistance which he demonstrated, because of the reproductive failure, he concludes: "The fact then remains that at present aquatic amebas are rigidly separable into two groups, one group living in fresh water the other in salt water." With our Great Salt Lake much saltier than the ocean, *Amoeba flowersi* living therein, though very resistant to varying concentrations, can by no stretch of the imagination be regarded as equivalent to any fresh water species.

Readers interested in changes in protozoans at varying concentrations may not have found Dean Pack's (1919) classical account of such variations of *Uroleptus packii* Calkins and *Prorodon* (now *Chilophyrya*) *utahensis* (Pack), both inhabitants of Great Salt Lake

(figs. 4 and 5). These in our culture, along with *Chlamydomonas* (fig. 6) and the brine shrimps, *Artemia gracilis* Verrill, were depauperate, hence our specimens of *Amoeba flowersi* approach the lower limit. Dr. Flowers' culture contained specimens more nearly the size described by Pack. Our culture was constantly airated for over a year, whereas that of Dr. Flowers was not. In the former, reproduction was much speeded up, many generations of brine shrimps appeared, and their hibernation was prevented from their appearance two weeks after the time of collection, June 8, 1943, till Aug. 1944 when they again hibernated. *Amoeba flowersi* first appeared in numbers in Feb. 1944. Dr. Flowers' culture was taken from the same locality in Jan. 1943.

Euglena chamberlini new species

A small species inhabiting the waters of Great Salt Lake. Named for Dr. Ralph V. Chamberlin, head of the Biology Dept., University of Utah. Type locality, Garfield Beach, Great Salt Lake, Utah. Type figure 7.

Length approximately 20 micra, probably usually larger. Proportions and general appearance much like *Euglena gracilis* Klebs. Nucleus elongate. Body with chromatophores and pyrenoids. Paramylon bodies not observed. Flagellum less than body length. Stigma small. Vorheis (1917) reports seeing a similar *Euglena* once. Miss Kirkpatrick also glimpsed it, but it escaped before she could make a tracing. I have seen only the one specimen in all by observations on *Amoeba flowersi*. Fortunately I had the mount under oil immersion and had the camera lucida adjusted for outlining. The specimen was active at first, then became immobilized by the pressure of the coverglass. It disintegrated from pressure, soon after the tracing and observations were made.

In the historical discussion of L. P. Johnson's (1944) paper, are mentioned Carter's (1937) description of *Euglena vermiformis* in brackish water and Wermal's (1924) description of *Euglena sima* in marine water, species from a somewhat similar habitat.

Plate I.

Figs. 1, 2, and 3. Type figures of *Amoeba flowersi,* new species, showing three successive forms in the movements of one individual.

a — algal cell

n — nucleus

r — red pigment

Fig. 4. *Uroleptus packii* Calkins.

c.v. — contractile vacuole

Fig. 5. *Chilophrya utahensis* (Pack).

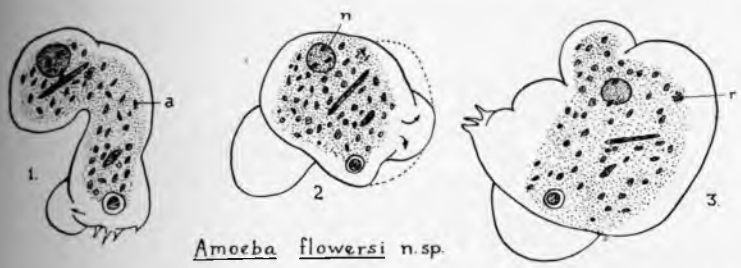
Fig. 6. *Chlamydomonas.*

Fig. 7. *Euglena chamberlini,* new species.

s — stigma

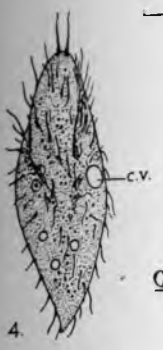
Fig. 8. Cyst of *Amoeba flowersi* Jones.

Figs. 9, 10, 11, and 12. *Amoeba flowersi* Jones.—Successive figures showing the movement of one individual. One broad pseudopodium dominant as in figure 10, at 20 per cent concentration.



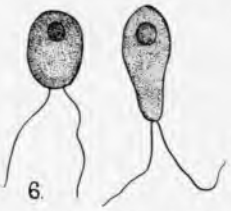
Amoeba flowersi n.sp.

50 μ



Uroleptus packii Calkins

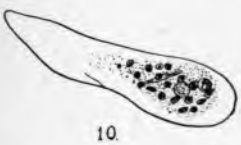
Chilophrya utahensis (Pack)



Chlamydomonas

Euglena chamberlini n.sp.

Cyst of Amoeba flowersi Jones



Amoeba flowersi Jones

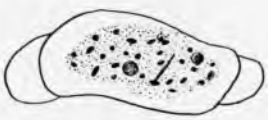
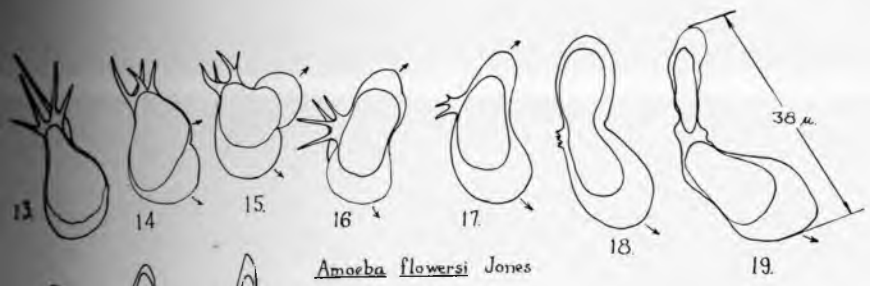


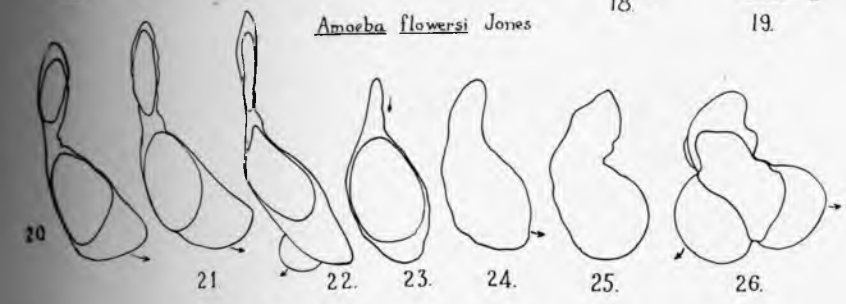
Plate II.

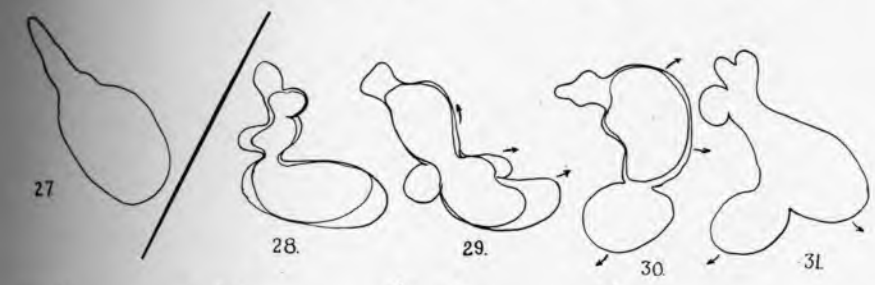
Figs. 13-27. *Amoeba flowersi* Jones.—Dr. S. Flowers' figures of the successive movements of one individual.

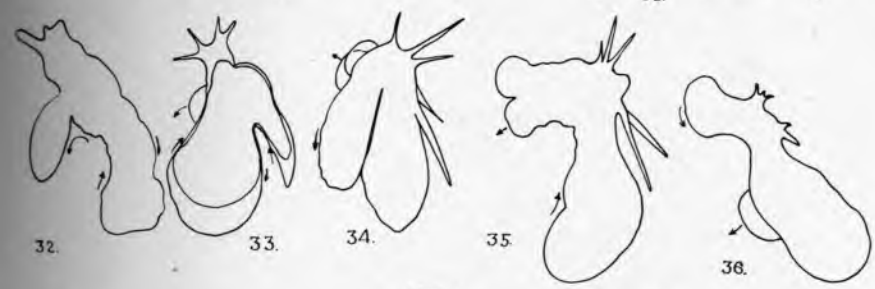
Fig. 28-39. *Amoeba flowersi* Jones.—Dr. S. Flowers' figures of the successive movements of another individual.

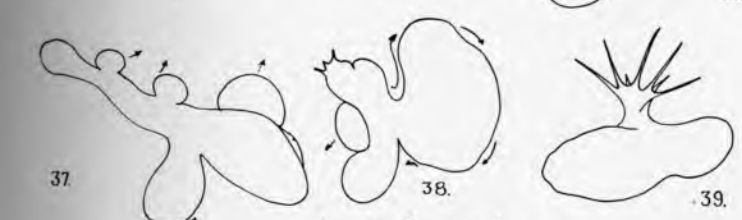


Amoeba flowersi Jones









Amoeba flowersi Jones

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